

## Descriptions of final-instar larvae of *Chlorolestes* Sélys (Odonata: Zygoptera; Synlestidae) from southern Africa, with a key to species

Brian C. Wilmot

National Festival of Science, Engineering & Technology, Grahamstown Foundation, P.O. Box 304, Grahamstown 6140, South Africa; e-mail: bugs@foundation.org.za

The seven known species of the genus *Chlorolestes* Sélys are endemic to southern Africa, namely: *C. apricans* Wilmot, *C. conspicuus* Sélys, *C. draconicus* Balinsky, *C. elegans* Pinhey, *C. fasciatus* (Burmeister), *C. tessellatus* (Burmeister) and *C. umbratus* Sélys. Final-instar larvae of these seven species are described and figured, based on material from South Africa and Zimbabwe. An identification key, based on characters of the final-instar larvae is provided, and distribution maps are plotted and discussed for species of the genus. The effects of temperature on the rate of larval growth is discussed.

**Keywords:** Odonata, Synlestidae, southern Africa, larvae, nymphs, immature stages, taxonomy.

### INTRODUCTION

The genus *Chlorolestes* Sélys, 1862, is endemic to southern Africa, and is represented by seven known species, which are largely restricted to montane habitats in rivers and streams. The genus is included by Brinck (1955), in what he terms the palaeogenic and palaeo-endemic 'Old Element' of the Afrotropical fauna.

Adults of the southern African species are well documented and good identification keys are available (Pinhey 1951; Tarboton & Tarboton 2005). Larvae are poorly known, however, and the final-instar larvae of the species *C. conspicuus* (Barnard 1921, 1937), *C. elegans* (Pinhey 1958) and *C. fasciatus* (Samways & Whiteley 1997; Samways & Wilmot 2003), have been previously illustrated, but incompletely described. Comparative identification keys to final-instar larvae are not available.

This paper provides detailed descriptions of the final-instar larvae of the seven known species, together with an identification key. Distribution records of the species are also provided based on adult specimens housed in institutional collections and recorded in the literature.

Following Pinhey (1951, 1984), *C. longicaudus* (Burmeister, 1839) is not deemed to have specific status and is included with *C. tessellatus*, which has priority.

## MATERIAL AND METHODS

With the exception of *C. elegans* Pinhey, 1950, the description of which is based on that of Pinhey (1958) and a single penultimate instar larva (F1) from the Vumba Mountains, Zimbabwe (National Museum of Zimbabwe, Bulawayo), all material was collected in the field by the writer. Species determinations result from teneral imagines reared in the laboratory. The exuviae of these specimens, together with final-instar larvae collected from sites unique to the particular species as evidenced by the adults present, are used for description.

All material is stored in 70% ethyl alcohol. Permanent mounts using euparal, cleared in 5% potassium hydroxide (KOH) where required, were made of the antenna, prementum, proventriculus, and caudal appendages.

Illustrations were prepared using a binocular microscope with a *camera lucida* attachment. Measurements were taken to the nearest 0.1 mm using a micrometric eye-piece. The following measurements were taken. (Dorsal aspect): total body length (midline from front of head to base of median caudal appendage, including pedicel); head width (widest point across the eyes); antennal length (total of individual segments); prementum length and width (flattened; length on midline from anterior margin to labial suture; width at widest point at base of labial palps); and wing sheaths (midline from anterior margin to apex). (Lateral aspect): caudal appendages (length excluding pedicel along median axis from base to apex; width at widest point). Following Chutter (1961), only entire caudal appendages were measured, i.e. regenerating appendages were excluded.

In order to prevent repetition the final-instar larva of *C. tessellatus* is described in full, with other species of the genus compared to it. The terminology used for the labium follows Corbet (1953), as elaborated on in Samways & Wilmot (2003). It should be noted that 'Albert District' cited by Ris (1921) as a record for *C. fasciatus* is not 'Prince Albert', as interpreted by Barnard (1937), but the historic name of 'Burghersdorp' in the Eastern Cape Province (C.J. Skead pers. comm.).

Distribution maps (Figures 34–38) are based on records provided by Balinsky (1956), Barnard (1937), Brinck (1955), Pinhey (1950, 1951, 1958, 1984), Ris (1921) and Wilmot (1975), and confirmed determinations of adult material housed in: Albany Museum, Grahamstown, South Africa (AMGS); Durban Museum, Durban, South Africa; Nasionale Museum, Bloemfontein, South Africa; Natal Museum, Pietermaritzburg, South Africa; Natural History Museum of London, London, United Kingdom; Natural History Museum of Zimbabwe, Bulawayo, Zimbabwe (NMBZ); Rhodes University, Grahamstown, South Africa; Royal Scottish Museum, Edinburgh, Scotland, United Kingdom; South African Museum, Cape Town, South Africa; Transvaal Museum, Pretoria, South Africa; University of Stellenbosch, Stellenbosch, South Africa; University of the Witwatersrand, Johannesburg, South Africa.

## SYSTEMATICS

KEY TO FINAL-INSTAR LARVAE OF *CHOROLESTES* SÉLYS

1. Antennae without ‘wart-like’ structure at bases (as in Figure 14) (except in *C. fasciatus* in which they are only vaguely evident), and pedicel either the longest antennal segment, or equal to each of 1<sup>st</sup> and 2<sup>nd</sup> flagellar segments (Figures 20–23); labial palp with intermediate hook toothed distally, end hook with distinct tooth at base above serrations or  $\frac{1}{10}$  length of hook, and outer basal angle without dark spot (Figures 27–30); proventriculus with eight major and eight minor folds, all toothed (Figure 7); caudal appendages broad, lamellate with pedicels and dark vertical band half to two-thirds along length (Figure 8 & 9), setae along margins of appendages short and fine except on dorsal edge of median appendage and ventral edges of lateral appendages, where spinulose (Western and Eastern Cape, Lesotho, KwaZulu-Natal, Mpumalanga, North West and Limpopo Provinces, Inyanga Mountains on Zimbabwe/Mozambique border) ..... 2. Subgenus *Euchlorolestes* Barnard
  - Antennae with ‘wart-like’ structure at bases (Figure 13), and pedicel the longest segment of antenna; labial palp with intermediate hook toothed or not toothed distally, and end hook with or without tooth (Figures 31–33); proventriculus with eight major and eight minor folds, with teeth only on major folds (Figure 15); caudal appendages broad, lamellate with pedicels, and colour pattern being either broad vertical band expanded terminally on median axis with dark spots flanking median axis in posterior two-thirds, or being variously mottled, with all margins with spines and spiniform setae or dorsal and ventral margins of both median and lateral appendages with setae not in single row, but multiple and every second one robust (as in Figures 16–17, 18–19) (Western Cape and Eastern Cape Provinces of South Africa) ..... 5. Subgenus *Chlorolestes sensu stricto*
2. Total length (excluding caudal appendages) generally 24–26 mm, but reaching 30 mm in *C. tessellatus*; antenna with scape equal to length of 2<sup>nd</sup> flagellar segment (Figures 20, 21, 23); end hook of labial palp with basal tooth immediately adjacent to serrations of inner margin (Figures 27, 28, 30) ..... 3
  - Larger species, with total length (excluding caudal appendages) greater than 30 mm; antenna with scape distinctly shorter than 2<sup>nd</sup> flagellar segment (Figure 22); end hook of labial palp with basal tooth not adjacent to serrations of inner margin, but approximately  $\frac{1}{10}$  length of end hook (Figure 29) ..... *C. draconicus* Balinsky
3. Antenna with pedicel, 1<sup>st</sup> and 2<sup>nd</sup> flagellar segments approximately equal in length (Figures 20, 21); caudal appendages with distinct, dark vertical band approximately  $\frac{2}{3}$  of length (Figure 8 & 9) ..... 4
  - Antenna with pedicel longer than either 1<sup>st</sup> or 2<sup>nd</sup> antennal segments; caudal appendages with very broad diffuse brown traverse band centrally placed ..... *C. elegans* Pinhey

4. 'Wart-like' structures at bases of antennae as in *C. conspicuus*; only vaguely evident; anterior margin of prementum with 14–18 serrations to either side of mid-line; labial palps with end hook long, narrow and sharp-pointed, and tooth at base sharp and narrow (Figure 28); abdomen with lateral spines on terga 5(6)–7 feeble, and sharp on terga 8 and 9; cerci in both sexes as in *C. umbratus*, with male long, notched at base on ventral margin, and tapered to a blunt point, and female short with broad base, and dorsal surface excised from  $\frac{2}{3}$  of length to give tapered apex ..... *C. fasciatus* (Burmeister)
- 'Wart-like' structures at bases of antennae absent (Figure 14); anterior margin of prementum with 18–20 blunt serrations to either side of mid-line (Figure 4); labial palps with end hook bluntly-pointed (Figures 3, 27); abdomen with distinct lateral spines on terga 6–9; cerci in male long, upcurved, notched at base on ventral margin, and  $\frac{1}{3}$  from base tapered to blunt point, and in female short, acutely pointed (Figure 10), and in both sexes curve outward from mid-line of body ..... *C. tessellatus* (Burmeister)
5. Large species with total length (excluding caudal appendages) generally 27–31 mm; antenna with scape 0.6 x length of pedicel, and shorter than each of 1<sup>st</sup> and 2<sup>nd</sup> flagellar segments (Figure 24); labium generally subquadrate compared to other species with width 0.8 x length; anterior margin of prementum with no serrations; labial palps with intermediate hook not toothed distally, end hook with no tooth at base, outer basal angle with dark spot, and serrations on median margin less distinct than in other species (Figure 31); caudal appendages broad, lamellate with pedicels, and colour pattern being broad, dark vertical band expanded terminally on median axis with dark spots flanking median axis in posterior  $\frac{2}{3}$ , all margins with spines and spiniform setae, and median appendage width approximately 0.5 x length and lateral appendages 0.45 x length (Figures 16–17) ..... *C. conspicuus* Sélys
- Small species with total length (excluding caudal appendages) generally 17–22 mm; antenna with scape 0.7 x length of pedicel, and shorter than, or equal to, each of 1<sup>st</sup> and 2<sup>nd</sup> flagellar segments; labium with prementum triangular-shaped, flat and elongated with width 0.7 x length, and anterior margin of prementum with blunt serrations; labial palps with intermediate hook toothed or not toothed distally, end hook with or without tooth at base, outer basal angle with or without dark spot, and serrations on median margin of palp rounded and incised as in all other species, except *C. conspicuus*; caudal appendages broad, lamellate with pedicels, and colour pattern variously mottled with dorsal and ventral margins of both median and lateral appendages with setae not in single row, but in multiple rows and every second seta robust, median appendage with width at most 0.45 x length and lateral appendages at most 0.4 x length ..... 6
6. Antenna with scape equal to each of 1<sup>st</sup> and 2<sup>nd</sup> flagellar segments (Figure 25); labium with anterior margin of prementum having 16–18 blunt serrations to either side of mid-line, four distinctive brown spots along each lateral margin, and labial palps with

- intermediate hook blunt and not toothed distally, end hook without tooth at base, and outer basal angle with dark spot (Figure 32); legs with two dark bands on tibiae and three on femora; abdomen with sharp lateral spines on terga 5–9; caudal appendages having colour pattern of brown band along mid-line and 10 (5 dorsal and 5 ventral) dark brown areas on outer margins, and width: length ratios of 0.45 for median appendage and 0.4 for lateral appendages (Figures 18 & 19) ..... *C. umbratus* Sélys
- Antenna with scape shorter than each of 1<sup>st</sup> and 2<sup>nd</sup> flagellar segments (Figure 26); labium with anterior margin of prementum having 12–14 blunt serrations to either side of mid-line, lateral margins uniform in colour, and labial palps with intermediate hook angled and toothed distally, end hook with or without tooth at base (Figure 33), outer basal angle uniform in colour; legs with two dark bands on both tibiae and femora; abdomen with sharp lateral spines on terga (6) 7–9; caudal appendages with colour pattern as above, but generally paler and less well defined, and width:length ratios of only 0.35 for median appendage and 0.3 for lateral appendages ..... *C. apricans* Wilmot

#### NEW DESCRIPTIONS OF FINAL INSTAR LARVAE

GENUS: *CHLOROLESTES* SÉLYS, 1862

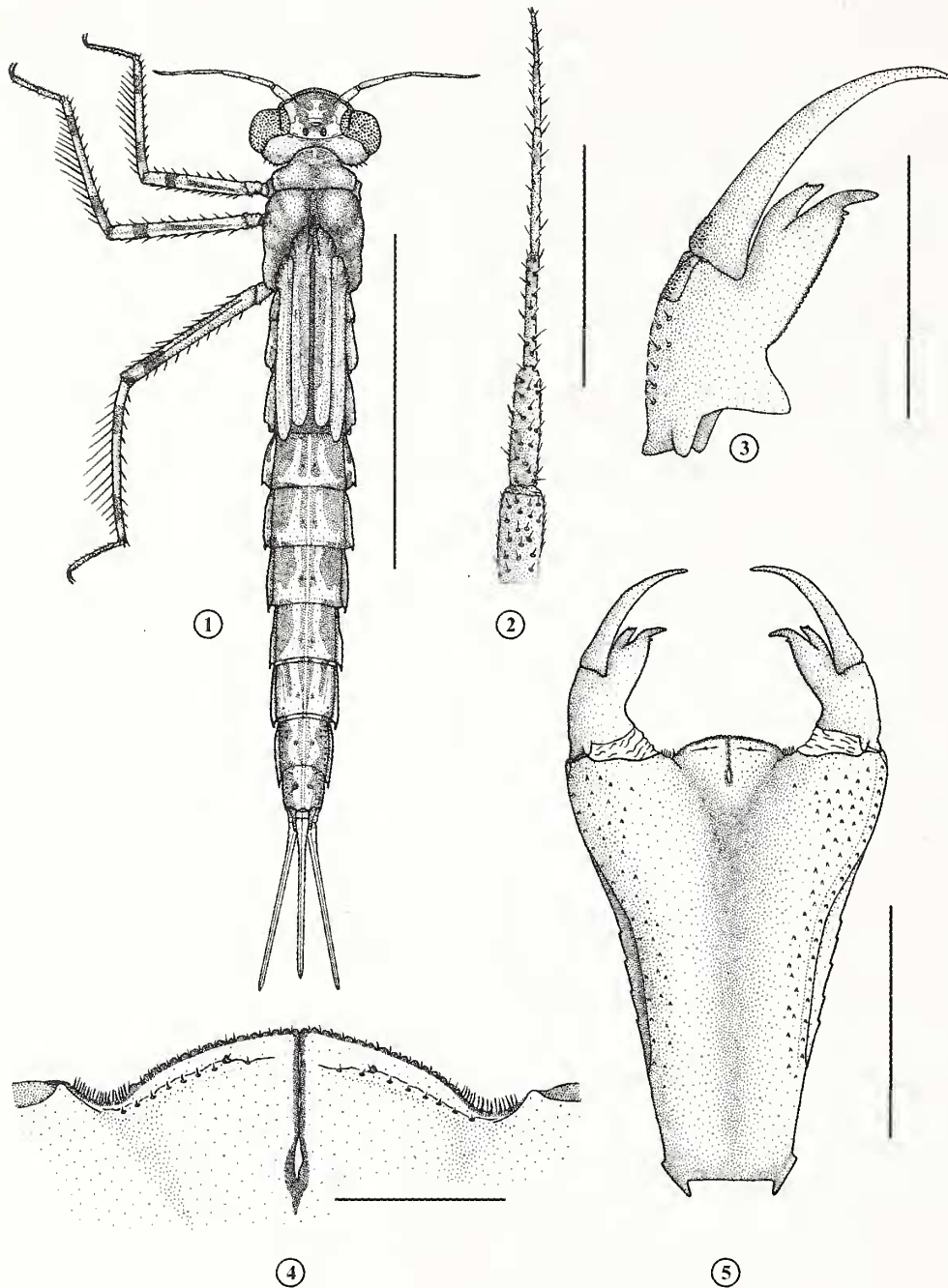
Type species: *Chlorolestes conspicuus* Sélys, 1862: 32

*Chlorolestes apricans* Wilmot, 1975: 13

Figures 26, 33 & 38

MATERIAL EXAMINED: 1♂, South Africa: Eastern Cape, Post Retief, Koonap River, 32°27'55"S, 26°30'55"E, 20.xi.1981, B.C. Wilmot; 1♀, same except: 1.xii.1981; 1♀ exuviae, same except: xii.1981 (AMGS).

DESCRIPTION: Head: Antenna as in *C. tessellatus*; generally slender in appearance, with scape, pedicel and five-segmented flagellum (Figure 26). Scape 0.7 (range: 0.7–0.7;  $n=3$ ) x length of pedicel; pedicel longer than each of 1<sup>st</sup> and 2<sup>nd</sup> flagellar segments, and flagellum 0.6 (range: 0.6–0.6;  $n=3$ ) x total length of antenna. ‘Wart-like’ structure at bases of antennae as in *C. conspicuus* and *C. umbratus*. Labium with prementum, similar to all other species of the genus, except *C. conspicuus*; triangular-shaped and tapered, with width 0.7 (range: 0.7–0.7;  $n=3$ ) x length. Anterior margin of prementum similar to *C. tessellatus*, but with 12–14 blunt serrations, with spiniform setae between, to either side of mid-line; lateral to these >10 piliform setae tightly spaced at base of each labial palp. Median lobe similar to *C. conspicuus* and *C. umbratus*, with single tooth and small



Figures 1–5. *Chlorolestes tessellatus* (Burmeister), final-instar larva. 1, larval habitus, dorsal aspect (excluding right legs); 2, antenna; 3, labial palp, left dorsal aspect; 4, anterior margin of prementum, dorsal aspect; 5, prementum with labial palps, dorsal aspect. Scale bars: 1 = 10 mm; 2 = 2 mm; 3 = 1 mm; 4 = 0.5 mm; 5 = 2 mm.

seta at base to either side of mid-line, and small setae more densely scattered than in *C. tessellatus*. Labial palps as in *C. tessellatus*, with long movable hook, but intermediate hook angled and toothed distally and end hook steeply inclined, with or without tooth at base (Figure 33). Serrations on median margin of palps rounded and incised as in all other species, except *C. conspicuus*. Mandibles, eyes and ocelli as in all other species of the genus (*vide C. tessellatus*).

Thorax: Proventriculus as in *C. conspicuus* with 2–4 teeth on each major fold.

Wing sheaths: All parallel with mesothoracic sheath to  $\frac{3}{4}$  distance across 3<sup>rd</sup> tergum, and metathoracic sheath to approximately posterior margin of 3<sup>rd</sup> tergum.

Legs: As in *C. tessellatus*, with two dark bands on both femur and tibia of all legs.

Abdomen: Sharp lateral spines on terga (6) 7–9; cerci in ♂ 2 x length of ♀, tapering and slightly upcurved terminally; ♀ short, tapering and wedge-shaped terminally, as in *C. umbratus*.

Genitalia: As in all other species of the genus (*vide C. tessellatus*).

Caudal appendages: Broad, lamellate with pedicels; colour pattern comprising brown band along mid-line and 10 (5 dorsal and 5 ventral), dark brown areas on outer margins of both median and lateral appendages. In this regard, similar to *C. umbratus*, but generally paler and thus less well defined. As in *C. umbratus*, dorsal and ventral margin of both median and lateral appendages with setae not in single row, but multiple and every second one robust. Narrowest of all species, including *C. umbratus*; median appendage with width only 0.35 x length and lateral appendages only 0.3 x length.

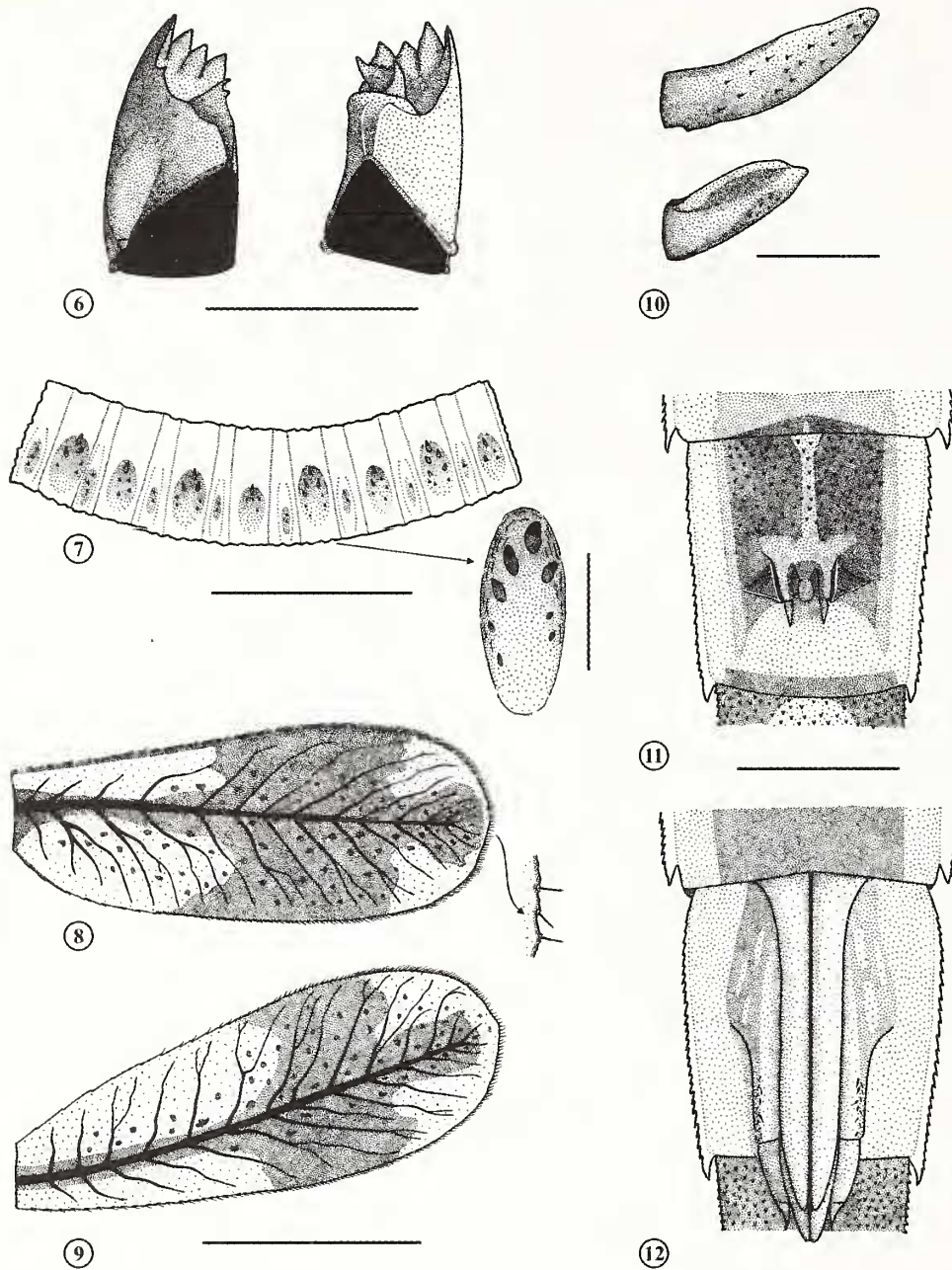
DIAGNOSIS: Generally as in *C. tessellatus*, but much smaller and comparable to *C. umbratus*. Dorsal surface of head with pattern similar to *C. tessellatus*; dorsum of terga 1–3 generally pale, terga 4–8 with central parts generally dark brown, with pale median stripe and a second curved stripe to either side, and terga 9 and 10 with expanded pale area. Lateral keels as in *C. umbratus*.

DISTRIBUTION: Restricted to the Winterberg/Amathole Mountains of the Eastern Cape Province (Figure 38).

*Chlorolestes conspicuus* Sélys, 1862: 32

Figures 13, 15–17, 24, 31 & 37

MATERIAL EXAMINED: 1♂, 2♀, South Africa: Western Cape, Table Mountain, Orange Kloof, 33°59'50"S, 18°23'45"E, 26.i.1976, B.C. Wilmot; 4♂; 1♂ exuviae, same except:



Figures 6–12. *Chlorolestes tessellatus* (Burmeister), final-instar larva. 6, mandibles; 7, proventriculus, flattened internal aspect, with enlargement of one major fold (arrowed); 8, median appendage, lateral aspect: with enlargement of marginal setae (arrowed); 9, lateral appendage; 10, cerci, lateral aspect: ♂ (above); ♀ (below); 11, external genitalia: ♂; 12, external genitalia ♀ (below). Scale bars: 6 = 0.5 mm; 7 = 1 mm; 8–9 = 2 mm; 10 = 0.5 mm; 11–12 = 1 mm.



27.i.1976; 4♀, Western Cape, Franschhoek Pass, 33°54'05"S, 19°09'30"E, 30.i.1976, B.C. Wilmot; 2♂, 1♀, Mitchell's Pass, 33°23'30"S, 19°17'00"E, 4.ii.1976, B.C. Wilmot; 3♂, 2♀, Jonkershoek, 33°59'25"S, 18°58'05"E, 3.ii.1976, B.C. Wilmot (AMGS).

DESCRIPTION: Head: Antenna as in *C. tessellatus*; generally slender in appearance with scape, pedicel and five-segmented flagellum (Figure 24). Scape 0.6 (range: 0.6–0.7;  $n=20$ ) x length of pedicel, which is longer than each of 1<sup>st</sup> and 2<sup>nd</sup> flagellar segments; and flagellum 0.6 (range: 0.5–0.6;  $n=20$ ) x total length of antenna. 'Wart-like' structure at bases of antennae as in *C. apricans* and *C. umbratus* (Figure 13). Labium generally subquadrate as compared to other species, with width 0.8 (range: 0.8–0.8;  $n=20$ ) x length, and extending posteriorly to the bases of mesothoracic sheath legs. Anterior margin of prementum without serration, only spiniform setae to either side of mid-line, and lateral to these >10 tightly spaced piliform setae at base of each labial palp. On median lobe a single tooth with seta at base to either side of mid-line as in *C. tessellatus*, but small setae more densely scattered. Labial palps as in *C. tessellatus*, except intermediate hook not toothed distally, end hook blunt and robust with no tooth at base, and outer basal angle with dark spot (Figure 31). Serrations on median margin of palps less distinct than in other species. Mandibles, eyes and ocelli as in all other species (*vide C. tessellatus*).

Thorax: Proventriculus with eight major and eight minor folds, with teeth only on major folds; 2–3 teeth on each major fold, with those on alternating major folds slightly smaller (Figure 15).

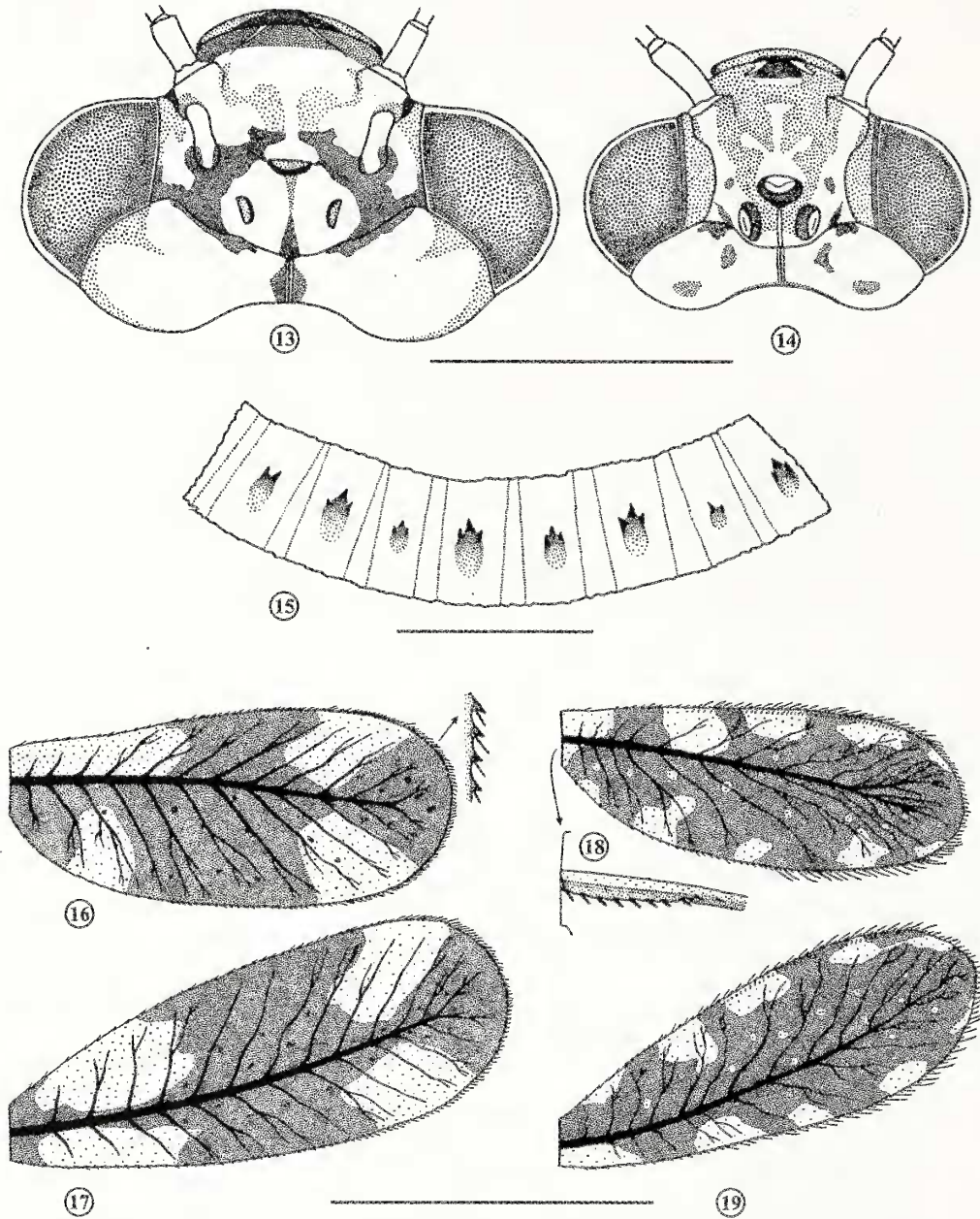
Wing sheaths: As in *C. tessellatus*, parallel with mesothoracic sheath to just short of posterior margin of 3<sup>rd</sup> tergum, and metathoracic sheath to just beyond this margin.

Legs: As in *C. tessellatus*, but on tibiae two brown-grey to black bands and three on femora; basal one on prothoracic femora feint/pale.

Abdomen: Sharp lateral spines on terga (5) 6–9; cerci in ♂, long, up-curved, dorsal edge with thickening midway along length, then tapering to a point; ♀ short, simple, and wedge-shaped.

Genitalia: As in all other species of the genus (*vide C. tessellatus*).

Caudal appendages: Distinctly broader, i.e. deeper than in other species; dark vertical band wider than in *C. tessellatus* and clearly expanded terminally on median axis; dark spots flanking median axis in posterior  $\frac{2}{3}$  only; median axis expanded laterally for less than  $\frac{1}{3}$  of length from base; all margins with spines and spiniform setae; median appendage width approximately 0.5 x length, and lateral appendages 0.45 x length (Figures 16 & 17).



Figures 13–19. *Chlorolestes* spp. final-instar larvae. 13, *C. conspicuus* Sélys, head, dorsal aspect; 14, *C. tessellatus* (Burmeister), head, dorsal aspect; 15, *C. conspicuus* Sélys, proventriculus, flattened interior aspect; 16, *C. conspicuus* Sélys, caudal appendage, lateral aspect; median appendage with enlargement of marginal spines and spiniform setae (arrowed); 17, *C. conspicuus* Sélys, lateral appendage; 18, *C. umbratus* Sélys, caudal appendage, lateral aspect; median appendage with enlargement of basal, lateral expansion of median axis (arrowed); 19, *C. umbratus* Sélys, lateral appendage. Scale bars: 13–14, 16–19 = 3 mm; 15 = 1 mm.

DIAGNOSIS: Generally as in *C. tessellatus*, except head with obvious dark ring around each ocellus and pale between ocelli (Figure 13), and abdomen darker than in *C. tessellatus* with terga mostly dark brown and lateral keels pale coloured.

DISTRIBUTION: Restricted to the southern region of the Western Cape Province (Figure 37).

*Chlorolestes draconicus* Balinsky, 1956: 511

Figures 22, 29 & 38

MATERIAL EXAMINED: 1♂, 4♂ exuviae, 1♀ exuviae, South Africa: KwaZulu-Natal, Royal Natal National Park, Mahai River, 28°41'10"S, 28°55'50"E, 12.xii.1974, B.C. Wilmot (AMGS).

DESCRIPTION: Head: Antenna as in *C. tessellatus*; generally slender in appearance with scape, pedicel and five-segmented flagellum (Figure 22). Scape 0.7 (range: 0.7–0.8;  $n=6$ ) x length of pedicel, and equal to length of 2<sup>nd</sup> flagellar segment; pedicel longer than each of 1<sup>st</sup> and 2<sup>nd</sup> flagellar segments; and flagellum 0.6 (range: 0.6–0.6;  $n=6$ ) x total length of antenna. No ‘wart-like’ structures at bases of antennae. Labium with prementum triangular-shaped, flat and elongated, as in *C. tessellatus*, with width 0.7 (range: 0.7–0.7;  $n=20$ ) x length; anterior margin of prementum as in *C. tessellatus*, except with approximately 12–14 blunt serrations, followed by 2–4 spiniform setae to either side of mid-line, and then >10 piliform setae tightly spaced at base of each labial palp; lateral to these with approximately 10 piliform setae at base of each lateral lobe. Median lobe as in *C. tessellatus*. Labial palps as in *C. tessellatus*, but end hook with broader base and sharp point; associated tooth not in contact with serrated inner margin, but approximately  $\frac{1}{10}$  length of end hook (Figure 29). Mandibles, eyes and ocelli as in all other species of the genus (*vide C. tessellatus*).

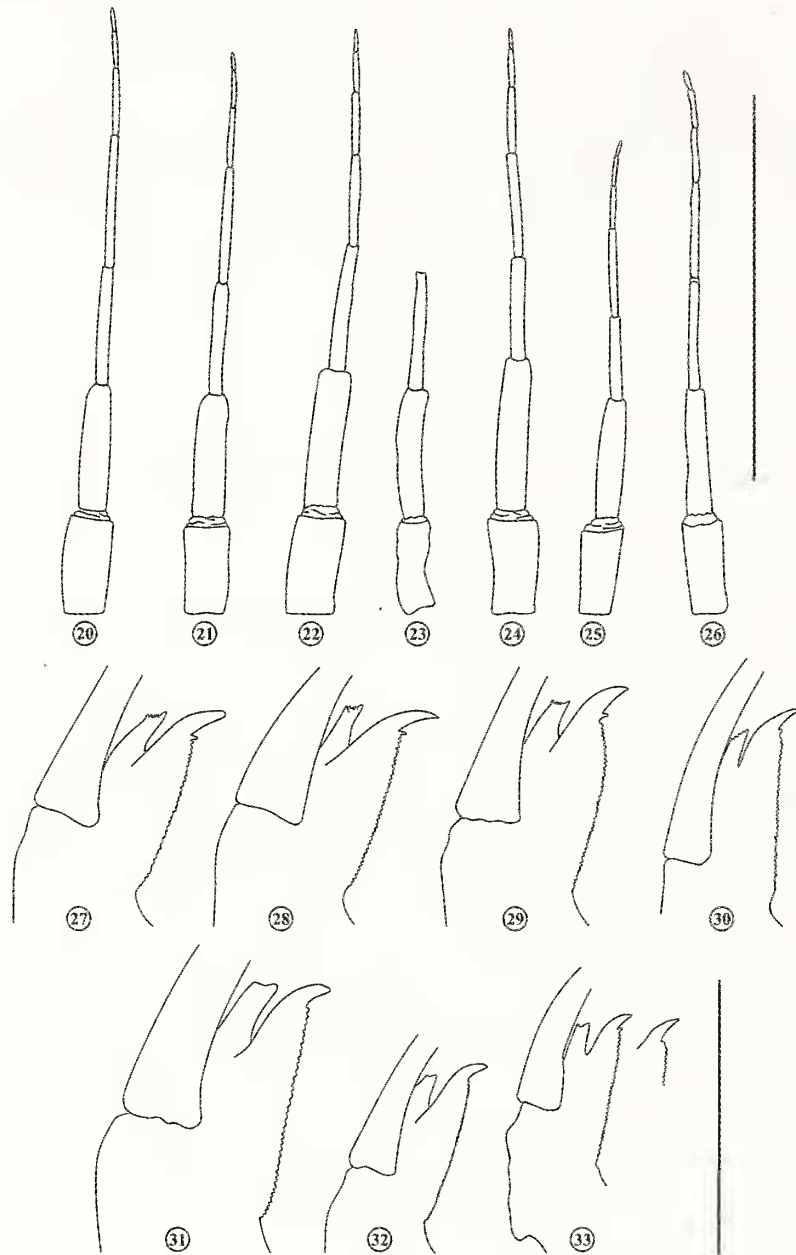
Thorax: Proventriculus as in *C. tessellatus*.

Wing sheaths: All parallel with mesothoracic sheath to just short of, or at posterior margin of 3<sup>rd</sup> tergum, and metathoracic sheath to just beyond this margin.

Legs: As in *C. tessellatus*.

Abdomen: Lateral spines on 5<sup>th</sup> tergum very small, and distinct on terga 8 and 9; cerci of ♂ long, similar to *C. fasciatus*; ♀ short, broad with down-turned blunt point.

Genitalia: As in other species of the genus (*vide C. tessellatus*).



**Figures 20–26.** *Chlorolestes* spp. final-instar larvae, antenna. 20, *C. tessellatus* (Burmeister); 21, *C. fasciatus* (Burmeister); 22, *C. draconicus* Balinsky; 23, *C. elegans* Pinhey (only scape, pedicel and 1<sup>st</sup> flagellar segments of penultimate instar); 24, *C. conspicuus* Sélys; 25, *C. umbratus* Sélys; 26, *C. apricans* Wilmot. **Figures 27–33.** *Chlorolestes* spp. final-instar larvae, labial palp. 27, *C. tessellatus*; 28, *C. fasciatus*; 29, *C. draconicus*; 30, *C. elegans* (penultimate instar); 31, *C. conspicuus*; 32, *C. umbratus*; 33, *C. apricans* (end hook shown with and without basal tooth). Scale bars: 20–26 = 3 mm; 27–33 = 1 mm.

Caudal appendages: As for *C. elegans*, *C. fasciatus* and *C. tessellatus*, with setae along margins of appendages short and fine, except on dorsal edge of median appendage and ventral edges of lateral appendages, where spinulose; median appendage with width approximately 0.4 x length, and lateral appendages marginally less so.

DIAGNOSIS: As in *C. tessellatus*, except dorsal abdominal colour more uniform, similar to *C. conspicuus*.

DISTRIBUTION: Restricted to high altitudes in the Natal Drakensberg Mountains (Figure 38).

*Chlorolestes elegans* Pinhey, 1950: 260

Figures 23, 30 & 38

MATERIAL EXAMINED: 1♂ (penultimate instar), Zimbabwe, Vumba Mountains, 19°07'S, 32°44'E, xi.1956, E.C.G. Pinhey (NMBZ).

DESCRIPTION: Head: Antenna as in *C. tessellatus*; generally slender in appearance, with scape, pedicel and five-segmented flagellum (Figure 23). Scape approximately 0.7 x length of pedicel, which is longer than each of 1<sup>st</sup> and 2<sup>nd</sup> flagellar segments. No 'wart-like' structures at bases of antennae. Labium with prementum triangular-shaped, flat and elongated, as in *C. tessellatus*, with width 0.7 ( $n=1$ ) x length; anterior margin of prementum as in *C. tessellatus*, but with approximately 16–18 blunt serrations, each with spatulate seta to either side of mid-line, and lateral to these >10 spiniform, not piliform, setae tightly spaced at base of each labial palp. Median lobe as in *C. tessellatus*. Labial palps as in *C. tessellatus*, with end hook blunt and robust and associated tooth immediately at base (Figure 30). Mandibles, eyes and ocelli as in all other species of the genus (*vide C. tessellatus*).

Thorax: Proventriculus as in *C. tessellatus*.

Wing sheaths: All parallel with mesothoracic sheath to posterior margin of 3<sup>rd</sup> tergum, and metathoracic sheath to 1/3 distance across 4<sup>th</sup> tergum; colour pattern of legs unknown (single available specimen badly bleached).

Abdomen: Lateral spines on terga (5) 6–9; cerci of ♂ bent up at 1/3 from base, then tapering to blunt point; ♀ no data.

Genitalia: As in all other species of the genus (*vide C. tessellatus*).

Caudal appendages: Simple, lamellate, yellowish, with very broad diffuse brown traverse band centrally placed (Pinhey 1958); median axis expanded laterally for less

than  $\frac{1}{3}$  of length from base; as in *C. draconicus*, *C. fasciatus* and *C. tessellatus*, with setae along margins of appendages short and fine, except on dorsal edge of median appendage and ventral edges of lateral appendages, where spinulose; median appendage with width approximately 0.4 x length, and lateral appendages marginally less so.

DIAGNOSIS: As in *C. tessellatus*, but the largest of the known species.

DISTRIBUTION: Only recorded from the Mpumalanga and Limpopo Provinces of South Africa, and the Inyanga Mountains on the Zimbabwe/Mozambique border (Figure 38).

*Chlorolestes fasciatus* (Burmeister, 1839: 36)

Figures 21, 28 & 36

MATERIAL EXAMINED: 3♂, 2♀, South Africa: KwaZulu-Natal, Drakensberg Gardens, 29°45'30"S, 29°13'50"E, 15.i.1974, B.C. Wilmot; 4♂, 1♂ exuviae, 1♀, 2♀ exuviae, KwaZulu-Natal, Royal Natal National Park, 28°41'10"S, 28°55'50"E, 10.xii.1974, B.C. Wilmot; 1♂ exuviae, 2♀ exuviae, same except: 12.xii.1974. 5♂, 2♀, Free State, Golden Gate National Park, 28°30'40"S, 28°30'40"E, x.1974, B.C. Wilmot; 2♂, 2♀, Eastern Cape, Amathole Mountains, Hogsback, 32°34'45"S, 26°56'10"E, 20.xi.1974, B.C. Wilmot (AMGS).

DESCRIPTION: Head: Antennae as in *C. tessellatus*; generally slender in appearance, with scape, pedicel and five-segmented flagellum (Figure 21). Scape 0.7 (range: 0.7–0.8;  $n=27$ ) x length of pedicel; pedicel with 1<sup>st</sup> and 2<sup>nd</sup> flagellar segments approximately equal in length; flagellum approximately 0.6 (range: 0.6–0.7;  $n=26$ ) x total length of antenna. ‘Wart-like’ structures at bases of antennae present, but unlike *C. apricans*, *C. conspicuus*, and *C. umbratus*, only vaguely evident. Labium with prementum triangular-shaped, flat and elongated, as in *C. tessellatus*, with width 0.7 (range: 0.7–0.7;  $n=27$ ) x length; anterior margin and median lobe of prementum also as for *C. tessellatus*, except on anterior margin with less blunt serrations, being 14–18 either side of mid-line, and then >10 piliform setae tightly spaced at base of each labial palp. Labial palps as in *C. tessellatus*, except end hook slightly longer, narrower and sharp-pointed, with tooth at base sharp and narrow (Figure 28). Mandibles, eyes and ocelli as in all other species of the genus (*vide C. tessellatus*).

Thorax: Proventriculus as in *C. tessellatus*.

Wings sheaths: As in *C. tessellatus*, i.e. parallel with mesothoracic sheath to just short of posterior margin of 3<sup>rd</sup> tergum, and metathoracic to just beyond this margin; legs also as in *C. tessellatus*.

Abdomen: Lateral spines on terga 5(6)–7 feeble, and sharp on terga 8 and 9. Cerci in ♂ long, notched at base on ventral margin, and tapering to a blunt point; ♀ short, with broad base and dorsal surface excised from  $\frac{2}{3}$  of length to tapered apex. Cerci in both sexes as in *C. umbratus*.

Genitalia: As in all other species of the genus (*vide C. tessellatus*).

Caudal appendages: As in *C. draconicus* and *C. tessellatus*; setae along margins of appendages short and fine, except on dorsal edge of median appendage and ventral edges of lateral appendages, where they are spinulose; median appendage with width approximately 0.4 x length, and lateral appendages marginally less so.

DIAGNOSIS: As in *C. tessellatus*; colour differences, if any, extremely difficult to distinguish.

DISTRIBUTION: Most frequently recorded on high altitude grassland streams, from the Eastern Cape Province through Lesotho, Free State, KwaZulu-Natal, and Swaziland to Mpumalanga, Gauteng, and North West and Limpopo Provinces (Figure 36).

*Chlorolestes tessellatus* (Burmeister, 1839: 35)

Figures 1–5, 6–12, 14, 20, 27 & 35

MATERIAL EXAMINED: 2♂, 1♂ exuviae, 4♀, 1♀ exuviae, South Africa: Eastern Cape, Amathole Mountains, Hogsback Inn, 32°35'45"S, 26°56'25"E, 14.xii.1971, B.C. Wilmot; 1♂, 5♀, same except: 23.xii.1971; 1♂, 3♀, same except: 18.iii.1972; 4♂, 1♀, same except: 17.xii.1972; 6♂, 9♀, same except: 29.xi.1973; 15♂, 13♀, same except: 13.ii.1974; 6♂, 3♀, Eastern Cape, Bloukrans River, Oak Valley, 33°19'15"S, 26°36'10"E, 17.i.1973, B.C. Wilmot; 7♂, 2♀, same except: 18.ix.1973; 7♂, 3♀, same except: 18.x.1973; 8♂, 7♀, same except: 21.xii.1973; 3♂, 3♀, same except: 15.i.1975 (AMGS).

DESCRIPTION: Head: Antenna slender, with scape, pedicel and five-segmented flagellum (Figures 2, 20). Scape 0.7 (*range*: 0.7–0.9; *n*=110) x length of pedicel; pedicel with 1<sup>st</sup> and 2<sup>nd</sup> flagellar segments almost equal in length; flagellum 0.6 (*range*: 0.6–0.7; *n*=110) x total length of antenna. No ‘wart-like’ structures at bases of antennae (Figure 14). Labium with prementum triangular-shaped, flat and elongated with width 0.7 (*range*: 0.7–0.8; *n*=113) x length (Figure 5); anterior margin with median cleft shallowly incised and almost closed and approximately 18–20 blunt serrations, each with spiniform seta to either side of mid-line; lateral to these >10 piliform setae tightly spaced at base of each labial palp (Figure 4). One tooth on median lobe, with small seta at base and small

setae thinly scattered to either side of mid-line. Setae conspicuous on lateral margins and dorsal surface immediately adjacent to these margins, except in basal quarter. Labial palps with distinctly curved, long movable hook, peg-like intermediate hook toothed distally, and bluntly-pointed end hook, with distinct tooth at base (Figures 3, 20). Inner margins of palps with serrations rounded and incised. Mandibles asymmetrical; left mandible with second row of teeth, and right with hook-like process posterior to main edge of four teeth (Figure 6). Eyes in mature larvae very large, as development of adult eyes beneath cuticle extends ommatidial surface medially to bases of antennae. Three clearly-defined ocelli present.

Thorax: Proventriculus with eight major and eight minor folds, all with teeth facing anteriorly towards oesophagus. Major folds normally each with 3–5 large teeth and a similar number of small teeth posterior to them; minor folds each with 1–4 teeth (Figure 7).

Wing sheaths: All parallel; mesothoracic sheath reaching to just short of posterior margin of 3<sup>rd</sup> tergum, and metathoracic sheath, to just beyond this margin (Figure 1). In specimens close to emergence wing sheaths are divergent, and venation of wings obvious beneath the cuticle.

Legs: With two bands of dark brown to grey-black on femur and tibia of all legs. Short spines along dorsal and ventral edges of femora, ventral edge of tibiae, and dorsal surface of tarsi; dorsal (outer) edges of tibiae with long setae and ventral surfaces of tarsi with feathered setae.

Abdomen: Segments keeled laterally, with distinct lateral spines on terga 6–9. Cerci in ♂ long, upcurved, notched at base on ventral margin, and  $\frac{1}{3}$  from base tapered to blunt point; ♀ short, acutely pointed (Figure 10); in both sexes curve outward from mid-line of body.

Genitalia: ♂ simple, with only single pair of gonopophyses either side of gonopore; ♀ with three pairs of gonopophyses (valvulae), large, extending beyond posterior margin of 9<sup>th</sup> abdominal sternum with first pair 1.2 x length of 9<sup>th</sup> abdominal sternum (Figure 11 & 12).

Caudal appendages: broad, lamellate, with pedicels and dark vertical band approximately two-thirds along length (Figure 8 & 9). Median axis expanded laterally, in basal quarter with teeth, and secondary tracheae obvious and oblique to main axis. Setae along margins of appendages short and fine, except on dorsal edge of median appendage and ventral edges of lateral appendages where spinulose. Median appendage with width approximately 0.4 x length, and lateral appendages marginally less so.

DIAGNOSIS: General appearance, long, slender and tapering, with caudal lamellae (Figure 1); head rounded with dark brown median band anterior of ocelli (Figure 14); thorax narrower than head; abdomen comprising ten segments, with dorsal pattern of



**Table 1.** Comparative measurements of final-instar larvae of *Chlorolestes tessellatus* (Burmeister) from two localities in the Eastern Cape, South Africa (mean followed by range in brackets, all in millimeters). Elevations: Hogsback (1 180 m.a.s.l.); Oak Valley (440 m.a.s.l.).

Measurements	Hogsback (Nov.–Dec.) (n=32, unless otherwise stated)	Hogsback (Feb.–Mar.) (n=32)	Oak Valley (Sept.–Nov.) (n=19, unless otherwise stated)	Oak Valley (Dec.–Jan.) (n=30)
Total length (excl. caudal appendages)	26.1 (23.0–30.0)	22.6 (18.5–30.0)	25.8 (24.0–28.5)	23.8 (21.0–27.8)
Head width	4.4 (4.2–4.7)	4.1 (3.9–4.5)	4.2 (4.0–4.5)	4.0 (3.7–4.1)
Antenna length (total)	5.0 (4.6–5.4); n=30	4.6 (4.2–5.3)	5.0 (4.6–5.6); n=18	4.9 (4.6–5.4)
Flagellum length	3.1 (2.9–3.5); n=30	2.9 (2.6–3.4)	3.2 (2.8–3.7); n=18	3.2 (2.8–3.6)
Prementum length	3.9 (3.8–4.2)	3.7 (3.4–3.9)	3.7 (3.5–3.9)	3.6 (3.3–3.9)
Prementum width	2.9 (2.7–3.0)	2.7 (2.6–2.9)	2.7 (2.5–2.8)	2.5 (2.3–2.7)
Wing sheaths length				
Mesothoracic sheath	6.4 (5.9–7.2)	6.0 (5.5–6.6)	6.3 (5.9–6.9)	5.9 (5.5–6.3)
Metathoracic sheath	5.9 (5.3–6.5)	5.6 (5.1–6.1)	5.8 (5.4–6.2)	5.5 (4.9–5.7)
Caudal appendages				
Median length	4.8 (4.3–5.4)	4.3 (3.7–5.0)	4.8 (4.6–5.3)	4.6 (4.1–5.0)
Median width	1.8 (1.6–2.1)	1.7 (1.5–1.9)	1.9 (1.7–2.0)	1.8 (1.5–2.1)
Lateral length	5.2 (4.8–5.8)	4.7 (4.1–5.5)	5.2 (4.9–5.7)	4.9 (4.3–5.4)
Lateral width	1.9 (1.7–2.1)	1.7 (1.5–1.9)	1.9 (1.7–2.0)	1.9 (1.7–2.0)

pigmentation as illustrated; colour variable, from pale brown on cream, black-brown on pale brown, to grey-black on light grey; ventral surface uniform white to brown. Lateral keels mostly pale brown or cream in colour.

**DISTRIBUTION:** Generally recorded from lower altitude woodland streams and rivers, from the Western Cape Province north through the Eastern Cape, KwaZulu-Natal, and Mpumalanga to Gauteng, North West and Limpopo Provinces (Figure 35).

*Chlorolestes umbratus* Sélys, 1862: 37

Figures 18, 19, 25, 32 & 38

**MATERIAL EXAMINED:** 1♂ exuviae, 1♀, South Africa: Western Cape, Bloukrans Pass, 33°56'55"S, 23°37'00"E, 29.vii.1970, B.C. Wilmot; 1♂ exuviae, 2♀, 1♀ exuviae, Kaaiman's River, 33°57'35"S, 22°32'20"E, x.1970, B.C. Wilmot; 4♂ exuviae, 2♀

exuviae, Jonkershoek Weir, 33°59'25"S, 18°58'05"E, 3.ii.1976, B.C. Wilmot; 1♂ exuviae, Garcia Forestry Station, 34°01'40"S, 21°13'25"E, 9.ii. 1976, B.C. Wilmot; 1♂ exuviae, Bloukrans Pass, 33°56'55"S, 23°37'00"E, 10.ii.1976, B.C. Wilmot (AMGS).

DESCRIPTION: Head: Antenna as in *C. tessellatus*; generally slender in appearance with scape, pedicel and five-segmented flagellum (Figure 25). Scape 0.7 (range: 0.7–0.7;  $n=14$ ) x length of pedicel, and equal to each of 1<sup>st</sup> and 2<sup>nd</sup> flagellar segments; pedicel longer than each of 1<sup>st</sup> and 2<sup>nd</sup> flagellar segments; and flagellum 0.6 (range: 0.5–0.6;  $n=10$ ) x total length of antenna. Scape brown in colour; proximal  $\frac{3}{4}$  of pedicel, all of 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> flagellar segments, and first half of 4<sup>th</sup> segment dark brown; terminal segment pale brown. 'Wart-like' structure at bases of antennae as in *C. apricans* and *C. conspicuus*. Labium with prementum triangular-shaped, flat and elongated, as in *C. tessellatus*, with width 0.7 (range: 0.7–0.7;  $n=13$ ) x length. Anterior margin of prementum similar to *C. tessellatus*, but with 16–18 blunt serrations to either side of mid-line, and lateral to these >10 piliform setae tightly spaced at base of each labial palp. Median lobe similar to *C. tessellatus*, with single tooth to either side of mid-line, but similar to *C. conspicuus*, in having more densely scattered small setae. Four distinctive brown spots along each lateral margin of prementum. Labial palps as in *C. tessellatus* with long movable hook, but intermediate hook blunt and not toothed distally, and end hook steeply inclined with no tooth at base (Figure 32). Serrations on median margin rounded and incised as in all other species, except *C. conspicuus*. Similar to *C. conspicuus* with dark spot on outer basal angle of palp. Mandibles, eyes and ocelli as in all other species (*vide C. tessellatus*).

Thorax: Proventriculus as in *C. conspicuus*.

Wing sheaths: All parallel with mesothoracic sheath only to half distance across 3<sup>rd</sup> tergum, and metathoracic sheath to approximately posterior margin of 3<sup>rd</sup> tergum.

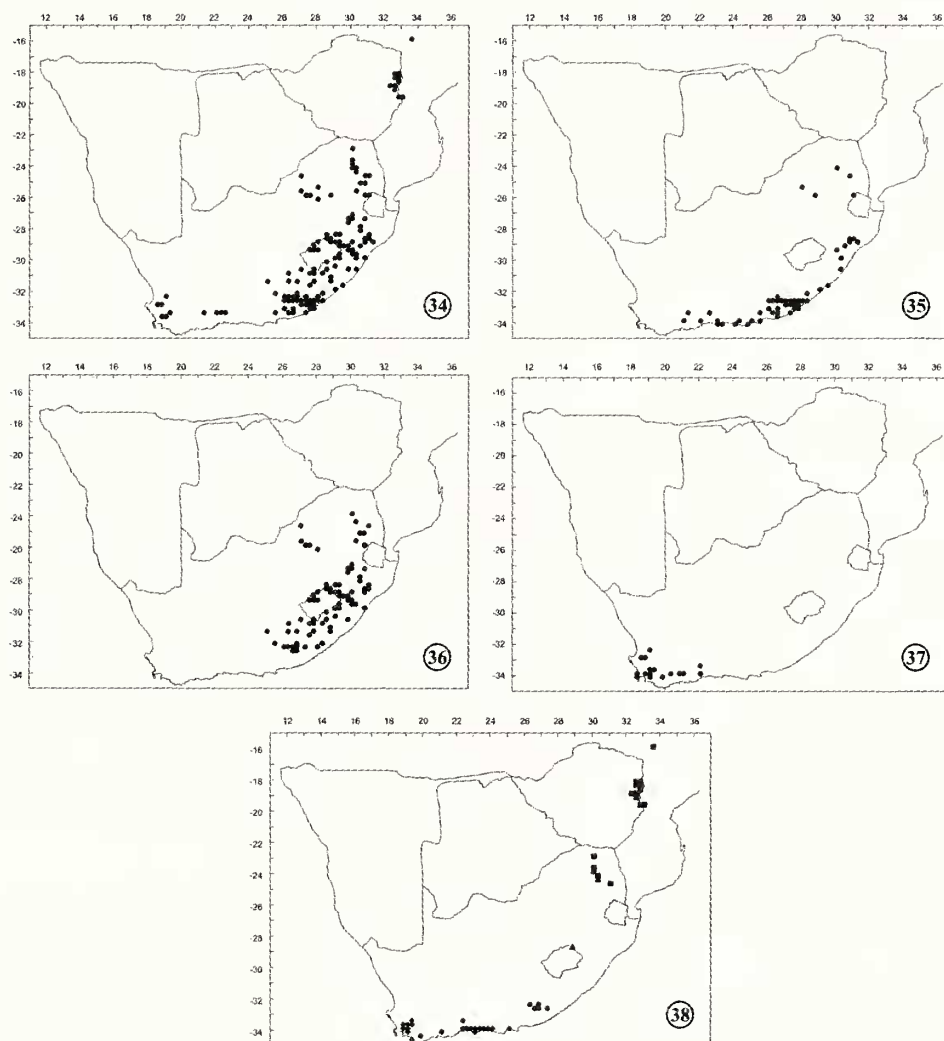
Legs: As in *C. conspicuus*, with two dark bands on tibiae and three on femora.

Abdomen: Sharp lateral spines on terga 5–9; cerci in ♂ long, upcurved tapering to bluntish point with notch at base of ventral margin; ♀ short, tapering and wedge-shaped terminally.

Genitalia: As in all other species of the genus (*vide C. tessellatus*).

Caudal appendages: Broad, lamellate with pedicels, and brown/dark brown in colour, except for five pale areas along dorsal and ventral margins and pale spots flanking median axis (Figures 18 & 19). As in *C. apricans*, dorsal and ventral margin of both median and lateral appendages with setae not in single row, but multiple and every second one robust. Median axis expanded laterally as in *C. tessellatus*. Median appendage with width approximately 0.45 x length and lateral appendages 0.4 x length.

DIAGNOSIS: Generally as in *C. tessellatus*, but much smaller, comparable with *C. apricans*. Dorsal surface of head with pattern similar to *C. tessellatus*; dorsum of abdomen with lateral spines having anterior half and posterior margins dark brown, central portion similar to *C. conspicuus*, but with lateral bands narrower and with dark, narrow band to either side of mid-line to just over mid-length of terga. Lateral keels with anterior half and posterior margin dark brown.



**Figures 34–38.** Distribution of southern African species of *Chlorolestes* Sélys. **34**, Coverage of records for *Chlorolestes* Sélys; **35**, *C. tessellatus* (Burmeister); **36**, *C. fasciatus* (Burmeister); **37**, *C. conspicuus* Sélys; **38**, *C. apricans* Wilmot (circle), *C. draconicus* Balinsky (triangle), *C. elegans* Pinhey (square), *C. umbratus* Sélys (lozenge).

DISTRIBUTION: Restricted to the southern region of the Western Cape Province and western coastal region of the Eastern Cape Province (Figure 38).

## DISCUSSION

The two subgenera, *Chlorolestes sensu stricto* and *Euchlorolestes*, erected by Barnard (1937) after Kennedy (1920) and reaffirmed by Pinhey (1951, 1962), are based on adult characters alone. Examination of the final-instar larvae, particularly characters of the proventriculus and caudal appendages, confirm such a subgeneric division. The final-instar larvae of *Chlorolestes sensu stricto*, comprising *C. apricans*, *C. conspicuus* and *C. umbratus* have the proventriculus with teeth only on the major folds, and caudal appendages with either a broad, dark vertical band expanded terminally on the median axis, with dark spots flanking the median axis in the posterior  $\frac{2}{3}$ , or variously mottled. Those of *Euchlorolestes*, comprising *C. draconicus*, *C. elegans*, *C. fasciatus* and *C. tessellatus* have the proventriculus with teeth on both the major and minor folds, and the caudal appendages with only a dark vertical band  $\frac{1}{2}$  to  $\frac{2}{3}$  along the length.

With regard to the final-instar larvae, inter-specific differences within each of the two subgenera are difficult to discern in some instances. For this reason attention is drawn to the known geographical distribution of the species (Figures 34–38). While some of the species are widely separated geographically, several species do overlap in their distribution, and of these the most difficult to separate are *C. fasciatus* and *C. tessellatus*, given their common size range and many shared attributes. Generally, *C. tessellatus* is most commonly found in lower elevation woodland streams and rivers and *C. fasciatus* in high elevation grassland streams, but they are known from common localities in montane areas of the Eastern Cape Province, KwaZulu-Natal, Mpumalanga, and the North West and Limpopo Provinces.

The influence of temperature on the growth of odonate larvae, and thus on the overall size they attain, is pertinent in this study, given the use of morphometric characters in

**Table 2.** Head width of final-instar larvae of *Chlorolestes tessellatus* (Burmeister) for each of spring and summer populations, from high elevation (Hogsback) and low elevation (Oak Valley) localities (*mean* followed by *range* in brackets, all in millimeters).

Site	Season	Degree-hours/day	Head width
Hogsback	Spring (Nov./Dec.)	29.9	4.4 (4.2–4.7)
<i>ditto</i>	Summer (Feb./March)	126.0	4.1 (3.9–4.5)
Oak Valley	Spring (Sept./Oct.)	48.8	4.2 (4.0–4.5)
<i>ditto</i>	Summer (Dec./Jan.)	159.0	4.0 (3.7–4.1)

both the descriptions and key. In as yet unpublished research on the life-cycle of *C. tessellatus* the writer has established that the species is bi-voltine with major adult emergences being in spring and summer. At one of the two Eastern Cape study sites, a high elevation one at 1 180 m.a.s.l. (Hogsback, Amathole Mountains), the emergences are in November/December and February/March respectively. At the second, a low elevation one at 440 m.a.s.l. (Oak Valley, Bloukrans River, near Grahamstown), the emergences are in September/October and December/January respectively. The four sets of measurements provided for *C. tessellatus* (Table 1), are for final-instar larvae collected in these periods.

To determine the influence of water temperature on the size of final-instar larvae, the average daily water temperature (based on continuous recordings using a mercury remote-thermograph and expressed as degree-hours above a 10°C base-line), was calculated for the growth periods of the larvae (from monthly samples) resulting in the spring and summer adult populations at each of the two sites, and compared with head-width measurements (mean and range in millimeters).

Adding to this, final-instar larvae bred through in the laboratory over the period of September–January at approximately 18°C (i.e. average of 192 degree-hours/day) had a head width of 3.7 mm (range: 3.5–3.9 mm;  $n=31$ ) (Table 2).

While the evidence points to water temperature influencing the size of final-instar larvae (i.e. colder water, larger larvae), of more importance in the context of this study is that inter- and intra-site differences in the size of final-instar larvae do occur, and accordingly cognizance must be taken of this in the identification of species.

Finally, need exists for further study, especially of *C. elegans* and *C. tessellatus*. In *C. elegans*, the description is based on a single penultimate-instar larva from Zimbabwe, the northern limit of its geographical range. Specimens from a wider range of sites, including Mpumalanga and Limpopo Province of South Africa, are required. The description of *C. tessellatus* is based on specimens from only two sites in the Eastern Cape Province, and given its wide range clear need exists to include the study of material from at least the Western Cape Province, KwaZulu-Natal and Mpumalanga.

#### ACKNOWLEDGMENTS

Editorial guidance provided by Michael Samways (University of Stellenbosch, South Africa), Mark Chutter (formerly of CSIR, Pretoria, South Africa), Ferdy de Moor and Ashley H. Kirk-Spriggs (Albany Museum) is acknowledged with grateful thanks. Information on distribution was kindly provided by the late Jack Skead. Martin Villet and Craig Peter (both Rhodes University) assisted with distribution maps.

## REFERENCES

- BALINSKY, B.I. 1956. A new species of *Chlorolestes* (Odonata) from Natal. *Annals of the Transvaal Museum* **22**: 511–514.
- BARNARD, K.H. 1921. Note on the life-history of *Chlorolestes conspicua*. *Annals of the South African Museum* **18**: 445–446.
- BARNARD, K.H. 1937. Notes on dragon-flies (Odonata) of the S.W. Cape, with descriptions of the nymphs, and of new species. *Annals of the South African Museum* **32**: 169–260.
- BRINCK, P. 1955. Chapter VII Odonata (pp. 191–233). In HANSTRÖM, B., BRINCK, P. & RUDEBECK (eds.). *South African animal life. Results of the Lund University Expedition in 1950–1951*. Volume 2, Almqvist & Wiksell, Stockholm, [vi] + 576 pp.
- BURMEISTER, F. 1839. Odonata 2. *Handbuch der Entomologie*, Berlin, **2**: 805–862, 1016–1017 + plates 1–6.
- CHUTTER, F.M. 1961. Certain aspects of the morphology and ecology of the nymphs of several species of *Pseudagrion* Sélys (Odonata). *Archiv für Hydrobiologie* **57**: 430–463.
- CORBET, P.S. 1953. A terminology for the labium of larval Odonata. *The Entomologist* **83**: 191–196.
- KENNEDY, C.H. 1920. Forty two hitherto unrecognized genera and subgenera of Zygoptera. *Ohio Journal of Science* **21**: 83–88.
- PINHEY, E.C.G. 1950. New species of Odonata from southern Africa. *Annals of the Transvaal Museum* **21**: 260–272.
- PINHEY, E.C.G. 1951. *The dragonflies of southern Africa*. Transvaal Museum Memoir No. 5, xvi + 335 pp.
- PINHEY, E. 1958. Records of dragonflies from the Zambezi and Rhodesia; a revision of the genus *Platycypha*; a gynandromorph dragonfly from Uganda. *Occasional Papers of the National Museum of Southern Rhodesia* **22B**: 97–116.
- PINHEY, E. 1984. A survey of the dragonflies (Odonata) of South Africa. Part 1. *Journal of the Entomological Society of Southern Africa* **47**: 147–188.
- RIS, F. 1921. The Odonata or dragonflies of South Africa. *Annals of the South African Museum* **18**: 245–445 + plates V–XII.
- SAMWAYS, M.J. & WHITELEY, G. 1997. *Dragonflies of the Natal Drakensberg*. University of Natal Press, Pietermaritzburg, South Africa, x + 78 pp.
- SAMWAYS, M.J. & WILMOT, B.C. 2003. Chapter 3 Odonata (pp. 160–212). In DE MOOR, I.J., DAY, J.A. & DE MOOR, F.C. (eds.). *Guides to the freshwater invertebrates of southern Africa*. Volume 7: Insecta I. Water Research Commission, Pretoria. WRC Report No TT 207/03, x + 288 pp.
- SÉLYS-LONGCHAMPS, M.E., DE. 1862. *Synopsis des Agrionines, seconde légion, Lestes*. *Bulletin de l'Académie r. de Belgique. Classe des sciences*. Sér. 2, **13**: 288–338 (pp. 3–54 sep.).
- TARBOTON, W. & TARBOTON, M. 2005. *A fieldguide to the damselflies of South Africa*. Modimolle, South Africa, 95 pp. [privately printed].
- WILMOT, B.C. 1975. A new species of *Chlorolestes* (Odonata: Synlestidae) from the Eastern Cape Province. *Journal of the Entomological Society of Southern Africa* **38**: 13–17.

**Appendix.** Comparative measurements of six species of *Chlorolestes* Selys final-instar larvae. For comparative measurements of *C. tessellatus* (Burmeister) vide Table 1.

Measurements	<i>Chlorolestes apricans</i> Wilmot	<i>Chlorolestes conspicuus</i> Selys	<i>Chlorolestes draconicus</i> Balinsky	<i>Chlorolestes elegans</i> Pinhey	<i>Chlorolestes fasciatus</i> (Burmeister)	<i>Chlorolestes umbratus</i> Selys
Total length (excl. caudal appendages)	19.3 (16.8–22.0); n=3	29.3 (27.0–31.0); n=19	32.5 (31.0–34.0); n=6	23.5 <sup>1</sup> ; n=1	25.9 (21.5–28.0); n=27	19.3 (17–22.0); n=13
Head width	3.5 (3.4–3.6); n=3	5.5 (5.0–5.7); n=19	4.5 (4.1–4.7); n=5	4.5; n=1	4.1 (4.0–4.5); n=27	3.5 (3.3–3.7); n=14
Antenna length (total)	4.1 (3.9–4.3); n=3	4.9 (4.3–5.3); n=20	4.5 (4.4–4.6); n=6	no data	4.8 (4.3–5.3); n=26	3.9 (3.6–4.2); n=10
Flagellum length	2.4 (2.3–2.6); n=3	2.8 (2.5–3.1); n=20	2.7 (2.6–2.9); n=6	no data	3.0 (2.6–3.5); n=26	2.3 (2.0–2.5); n=10
Prenemum length	3.1 (3.0–3.2); n=3	4.5 (4.0–4.7); n=20	4.6 (4.5–4.8); n=5	3.8; n=1	3.9 (3.5–4.3); n=26	3.1 (2.9–3.3); n=13
Prenemum width	2.2 (2.1–2.3); n=3	3.6 (3.2–3.7); n=20	3.3 (3.2–3.3); n=5	2.7; n=1	2.7 (2.5–3.1); n=26	2.2 (2.1–2.3); n=13
<i>Wing sheaths length</i>						
Mesothoracic sheaths	4.8 (4.5–5.1); n=3	7.7 (7.1–8.0); n=20	7.0 (6.8–7.0); n=6	6.5; n=1	5.8 (5.3–6.5); n=27	4.7 (4.3–4.9); n=14
Metathoracic sheaths	4.5 (4.3–4.7); n=3	6.9 (6.4–7.4); n=20	6.3 (6.1–6.4); n=6	5.9; n=1	5.3 (4.7–6.0); n=27	4.0 (3.7–4.5); n=14
<i>Caudal appendages</i>						
Median length	3.8 (3.7–3.9); n=3	5.5 (5.0–5.7); n=19	4.7 (4.6–4.7); n=5	4.5; n=1	4.5 (4.1–5.1); n=27	3.4 (3.1–3.9); n=13
Median width	1.3 (1.3–1.4); n=3	2.3 (1.9–2.6); n=19	2.0 (1.8–2.1); n=4	1.8; n=1	1.9 (1.7–2.1); n=27	1.4 (1.1–1.6); n=13
Lateral length	4.1 (4.1–4.2); n=3	5.5 (4.6–5.9); n=19	5.1 (4.9–5.2); n=6	4.8; n=1	5.0 (4.6–5.6); n=26	3.9 (3.4–4.3); n=14
Lateral width	1.3 (1.2–1.4); n=3	2.4 (1.9–2.5); n=19	2.1 (1.9–2.2); n=6	1.8; n=1	1.9 (1.7–2.1); n=26	1.5 (1.4–1.6); n=14

<sup>1</sup>Piney (1958) states “Length of full-grown larva, including gills: 27–28 mm, gills about 4.5 mm.”